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Achievements, outcomes and proposal for global accreditation of engineering education in developing countries

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Abstract

Engineering profession proposed a road map by directly putting the impact on economic growth through various means such as technology, learning, access and quality. It is envisaged that to maintain quality human resource in professional engineering, accreditation and assessment of engineering education requires focusing. This would foster engineering education for socio-economic development at all levels. Accreditation and assessment at regional/national level is based on monitoring of educational programs like curriculum, teaching and learning, equipment/laboratory facilities, student performance, etc., rather than outcomes-based assessments. Moreover, assessment is also vital to identify and realize achievements and goals through the engineering profession and to attain student learning outcomes in accordance with both institutional and professional criteria. One of the major concerns for assessment and accreditation of engineering profession is that in the developing countries (i.e., Pakistan) the accredited bodies constituted at the regional/national level are striving hard to set out uniform, transparent and precise accreditation models. However, in order to gain global acceptance, there is a great need to explore possibility of mutual recognition and global mobility of engineers. In this study, accredited bodies for engineering profession, how engineering programs intervening help to improve quality of education as well as outcomes in the economic development are assessed in an environment of continuous development. A uniform model for global recognition of this profession is proposed. The current auditing of the engineering programs in Pakistan and in Turkey are analyzed and the trends are presented in a comparative assessment study vis a vis their global status. This paper presents an insight for policy makers in higher education sector to redesign, upgrade and modify the existing initiatives in developing nations through the case study made for Pakistan and Turkey.

Keywords: Engineering programs; education; accrediation; assessment; engineering profession.

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1. Background

Accreditation of undergraduate and advanced engineering education programs is an important aspect of ensuring quality of education according to the national and international criteria and benchmarks. Accreditation involves an evaluation and assessment of undergraduate and postgraduate programs offered by universities and other educational providers, through a well-defined, peer review process in which endorsements based on broadly designated parameters and criteria are rendered. An accredited engineering program is judged as providing satisfactory preparation of graduates, to initially enter the profession as registered engineers and then develop their skills subsequently to the level of professional engineers. The accreditation process is designed to publicly assure the competence of graduates, independent of the certification and credentials provided by the institutions of engineering education. The accreditation parameters and detailed criteria discussed in this paper are a critical component of certification to government, prospective employers and industry about the professional knowledge and skills of the engineering graduates (PEC, 2007).

Due to the rising trends of globalization in quality education, there is requirement to boost uniform quality assurance processes at different levels such as universities, professional bodies, regional and international levels. Accreditation process is to recognize and acknowledge the value-addition in transforming students admitted to the program into capable technical professionals, having sound knowledge of fundamentals and an acceptable level of professional skills and personal competence for ready employability in responsible technical assignments.

The need and demand of technical and engineering education programs in Pakistan has considerably increased in last decades. Whereas such economic and industrialization growth in Asian countries like China, India, Singapore etc. is faster then else where in the world, However the implementation of quality assurance mechanism in engineering education is much slower in these countries. Moreover the policies are underway for the improving overall quality of education. In faster mobilization era engineering education requires global recognition for the survival of engineering profession. This can only be achieved by pursuing global accreditation models. In the paper many existing global accreditation models with their key strengths and weaknesses are reviewed, as well as requirements and suggestions for Pakistan Engineering Councils have been outlined to become the member of international accreditation bodies.

Accreditation bodies of Engineering Education

At this stage there is no evidence of the establishment and successful operation of an active and uniform international accreditation agency in engineering education (A Patil, G. Godner, 2007). However an important global consortium for an accreditation of engineering education is Washington Accord initiated with representatives of six engineering accreditation agencies in 1989. The main objective of Washington Accord is to recognize the substantial equivalence and accreditation system of various organization and engineering education programs in the signatory countries (Washington Accord, 2007). The others global consortiums like Dublin Accord 2002, Sydney Accord 2001 and European Accredited Engineer Project 2005 for global engineering accreditation agencies are also available. However the outcome based models for the measurement of student performance and engineering programs rather than institutions are still underdevelopment phase. Some of the major engineering accreditation models are discussed below.

United States

The Accreditation Board for Engineering and Technology (ABET) was established in 1932 for the promotion of the Engineering Education. The main strength of the ABET is to focuses on the programs accreditation criteria rather than institutional accreditation. ABET approved a competency model of knowledge, skills and attitudes required by the members of the accreditation panel (ABET, 2006). Measuring the student performance ABET has tested a new standard called Engineering Criteria (EC) 2000 (N. Soundarajan, 2000), the criteria focuses on students outcomes and performances rather than only obtaining grades (L. Schachterle, 1999). The criterion 03 of the EC 2000 program outcomes and assessment relates to student acquire knowledge during his study period. The outcome of the criterion is as below:

(a) an ability to apply knowledge of mathematics, science and engineering;
(b) an ability to design and conduct experiments, as well as to analyze and interpret **data;**
(c) an ability to design a system, component, or process to meet desired needs;
(d) an ability to function on multi-disciplinary teams;

(e) an ability to identify, formulate and solve engineering problems;
(l) an understanding of professional and ethical responsibility;
(g) an ability to communicate effectively;
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context;
(i) a recognition of the need for, and an ability to engage, in life long learning;
(j) a knowledge of contemporary issues;
(k) an ability to use the techniques, skills and modem engineering tools necessary for engineering practice. (L. Schachterle, 1999)

Moreover as per follow up reports of ABET the major concern has been the assessment methodologies for assessing professional skills which required more emphasis and consistency.

Europe

One of the important initiative taken in 1951 through the establishment of European Federation of National Engineering (FEANI) for the uniform accreditation process in Europe. Besides this many national accreditation systems are also available in Europe. The one of the uniform approach have been initiated such as EURopen ACrediated Engineer project (EUR-ACE) which facilitate free mobility of engineers within Europe. However many countries within Europe follow their own criteria and assessment methodologies which result confusion and difficulties.

Asia

Despite of very faster growing economic and industrialization zone, the uniform accreditation systems for substantial Engineering Education in the Asia is lacking behind and it is without mutual collaboration. The countries like India, China, Indonesia, Vietnam are in development phase of new systems. Overall polices of accreditation in this region are with a lot of variations. Moreover Japan Accreditation Board of Engineering Education (JABEE) and Institute of Engineers Singapore have recently joined the signatory of Washington Accord, whereas Accreditation Board of Engineering Education of Korea (ABEEK), the Engineering Accreditation Council of Malaysia (EAC) and Institute of Engineering Education Taiwan (IEET) joined as provisional members of Washington Accord (Washington Accord 2007)

Australia

Australia is founder signatory of Washington and Sydney Accord through these Accords, the engineers of Australia foster their recognition in countries like United States, United Kingdom, Hong Kong (SAR), New Zealand, Canada, South Africa etc (Engineers Australia, 2008).

Turkey

All educational institutions –engineering alike- have three important aims: research, education and social responsibility. In Turkey engineering education -with the vision to purpose advancing public welfare through the development of better-educated and qualified engineers- have made important contributions to development of the nation. As of 2006, out of 92 Universities in Turkey 79 have 93 have engineering schools with engineering departments offering total of 565, 04 years undergraduate programs in 51 different engineering disciplines. There are 19 professional engineering societies in Turkey and membership to them is compulsory for practicing the engineering education. Outcomes based evaluation system MUDEK has also been formed in 2002 (MUDEK 2007). Moreover with short span of time the MUDEK become the legal entity as independent, non Government organization for evaluation in 2007. One of the effective evaluation process the MUDEK have, to determine whether a given program satisfies a set of criteria instead of based on individual ranking. Criteria used for MUDEK is to promote quality of engineering education and it also assure the engineering and technical programs meets the given criteria of MUDEK. Moreover for the continuous improvement process ABET substantial equivalency has been acquired in Turkey to strengthen and promote the higher education in Europe as per the Bologna Declaration 2004 in which Turkey also participated.

Pakistan

Pakistan's record on the education front has not been impressive. No doubt some progress and initiatives from last decades has been made, but it has been rather slow. The basic education are facing difficulties like low level public expenditure, difficult access to school education, lack of infrastructure etc. Due to reasons the student ratio reached to universities are not in large number. As per the Higher Education statistics only 7% of students could be enrolled in Engineering Programs. Moreover education reforms and initiatives have been taken for overall improvement of education system in Pakistan.

In Pakistan, New institutions offering programs of engineering must complete a process of initial accreditation by

PEC EA&QEC is to accord accreditation, not to the institution as a whole, but at the program level, for example, four-year under-graduate engineering degree course after 12 years of initial education. Furthermore, the programs are to be graded into three categories viz., Accredited up to three years, Pended for six months to ensure removal of shortfalls and Not Accredited, depending on the marks they achieve on a laid down scale. This is especially important for promoting a healthy competition for quality achievement among the different Degree/Diploma programs of the same institution, as well as among similar programs in different institutions. Thus, in a given institution, some programs may be accredited for three years, while some others may be accredited for one year and some even denied accreditation (PEC, 2007). Programs approved by the PEC are eligible to apply for reaccreditations. The PEC, EA&QEC has assessed and accredited 95 programs in the country's various public and private universities so far. However through the comparisons of accreditation models globally PEC should step forward to get into the process of becoming the member of Washington accord for the recognition of engineers profession globally.

Observations and Findings

Most of the accreditation and assessment models are influenced by the ABET guidelines, However each signatory of Washington Accord have their own accreditation process which have some variations, the standardization requires more focus in engineering accreditation. The major concern is in countries where no accreditation organization exists and to select the appropriate accreditation agency is second milestone, As number of different accreditation agencies available at national, regional and international levels. The learning and teaching should focus current industrial requirement so that local scientific problem solutions could be obtained as per industry requirement and same output can be used as socio-economic development. A recent report by Business Council of Australia (BCA) warns institutions for falling behind to meet the industry requirement. In a global perspective these accreditation bodies require to develop the uniform accreditation process so that engineers profession could be recognize within multicultural and multinational environment.

Despite of various assessments models developed for accreditation courses, these models needs more effective and transparent. As the developed countries have recently adopting the outcomes based models. ABET has recently experimented the same model which focused the knowledge applied effectively called Engineering Criteria 2000 (EC 2000) which is quite different from the previous procedures of ABET. The new procedure focuses on assess the success of engineering programs based on graduates achievements, fulfilling the general requirement of curriculum, ways to achieve the outcomes (a)-(k) mentioned above and demonstrate how to measure the students outcomes performance. The adoption of new procedure can effectively align whatever is being done for the improvement of learning, performance and outcomes of engineers in the form of quality.

Engineering Education in the Pakistan gone through problems such as low intake, shortage of lab equipment, no feedback systems from student, lack of academic counseling, difficult access to scientific tools and materials etc. Moreover reforms have been taken for improvement of higher education. Pakistan Engineering Council striving hard to meet the criteria for global accreditation models, moreover following steps is recommended for PEC to become the member of the international agencies:

- Form an independent Accreditation Board
- Board should be having consultative role to other PEC functions
- Chalk out a plan for awareness
- Standardize the Accreditation Procedures
- Make core policy level changes to meet the criteria of accord
- Standardize the educational practices in Pakistan
- Establish linkages with other member / prospective members
- Make a pilot project for some institution and their programs for Substantial equivalency
- Broaden the Finance base
- Consolidate the relevant data
- Follow Total Quality Management Practices

Conclusion

Accreditation provides opportunities for promotion and adoption of best practices, stimulation of innovation and diversity in engineering education. Accreditation provides assurance that the academic aims and objectives of the program are pursued and achieved through the resources currently available, and that the institution running the program has demonstrated capabilities to ensure effectiveness of the educational program(s), over the period of accreditation (PEC, 2007). This type of study is can be effectively utilize for the awareness to get into the in-depth analysis of accreditation models and to formulate similar study of other strategic organizations to keep the pace with changing scenario of world.

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